



# Deep Learning with CUDA

## Intro and first-steps

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**WFiIS AGH**  
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# At the beginning...



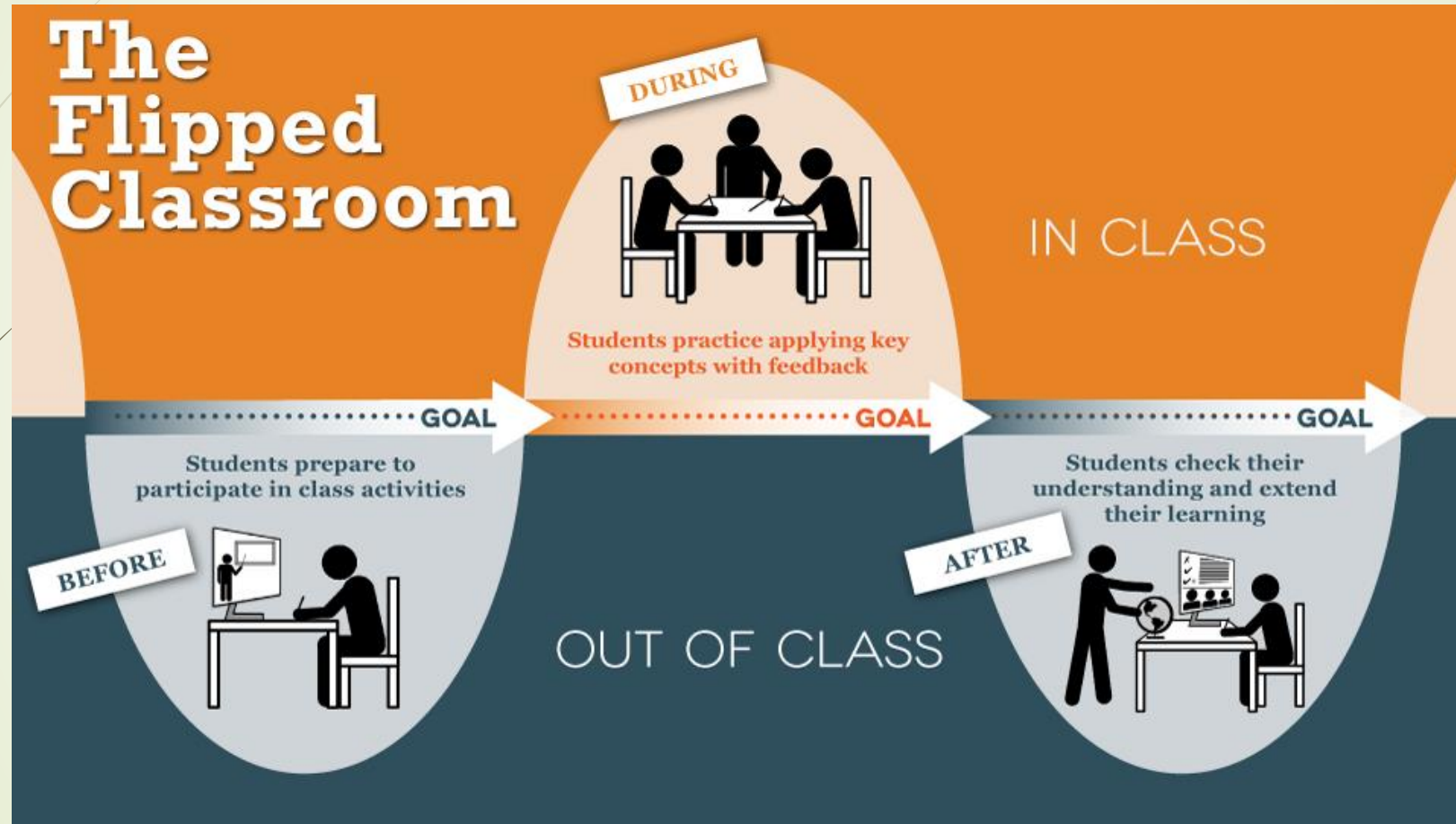
- ❑ Lecturer: **Tomasz Szumlak**, office: D11/111
- ❑ Consultations: **on demand – MS Teams!!**
- ❑ Contact: e-mail [\*\*szumlak@agh.edu.pl\*\*](mailto:szumlak@agh.edu.pl)
  
- ❑ OUTLINE of the LECTURE
  - 1) Lectures/seminars ~ **20** h
  - 2) Lab classes ~ **20** h
  - 3) Projects ~ **5** h
  
- ❑ Problems/questions/remarks – **talk to me!**
- ❑ Literature – **general materials**
  - There is so much good stuff...*
  - „Hands-on ML with SciKit-Learn and TF”*
  - „Deep Learning Illustrated”, Jon Krohn, et. al.*
  - Stack Overflow – Machine Learning*
  - Kaggle Discussion*

# At the beginning...



- ☐ Personal Toolkit is important
- ☐ I propose we use a combination of **colab**, as the execution environment, **Jupyter notebooks** as the medium and **PyTorch/Keras** as high-level i-face
- ☐ I want to be more of a **mentor** than a **coach**
- ☐ All activities will be either **flipped** or **inverted** meetings
- ☐ I count on **your collaboration** here or it will not work for us!!
- ☐ Projects – **building a team and peer review process**

# Flipped



# Inverted



# ML – what are you?



*[Machine learning is the] field of study that gives computers the ability to learn without being explicitly programmed.*

—Arthur Samuel, 1959

*A computer program is said to learn from experience  $E$  with respect to some task  $T$  and some performance measure  $P$ , if its performance on  $T$ , as measured by  $P$ , improves with experience  $E$ .*

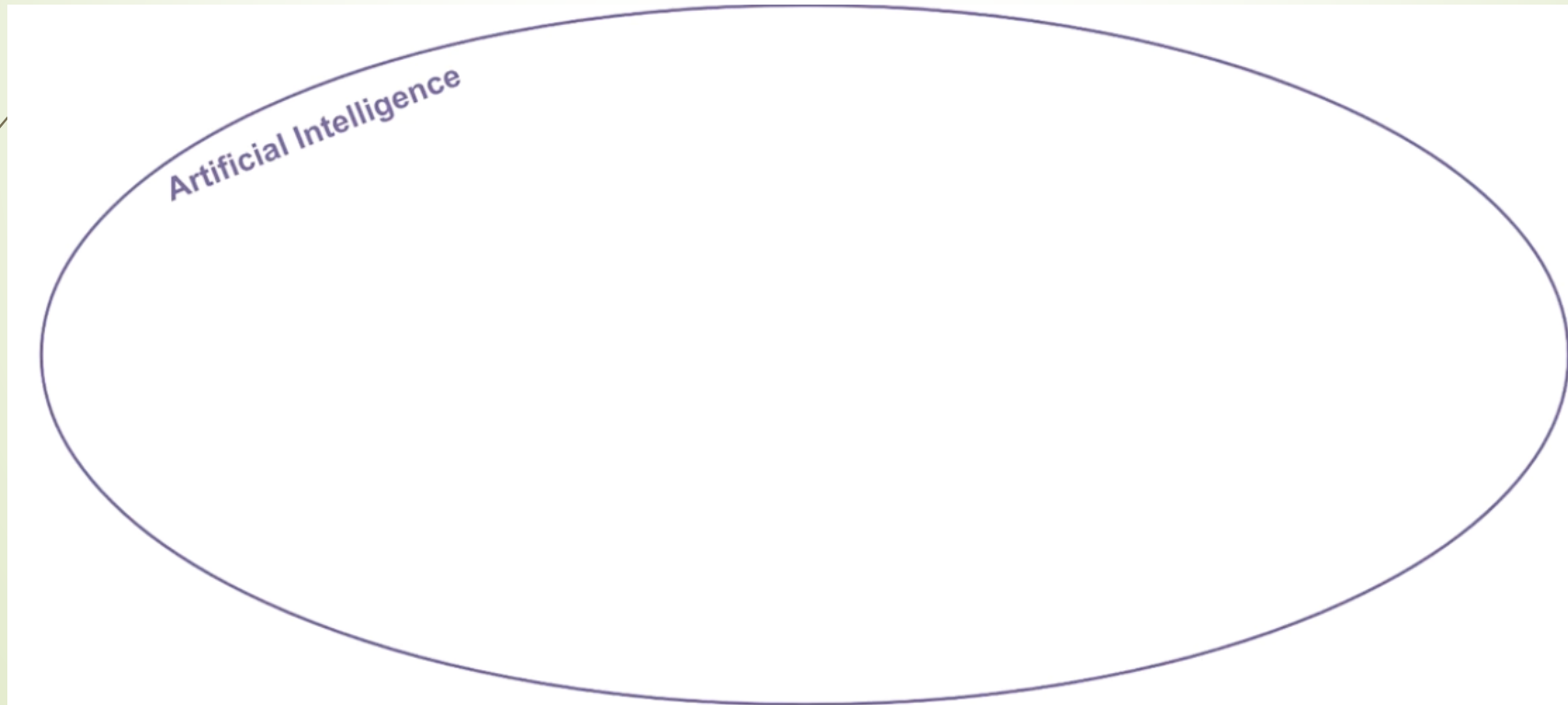
—Tom Mitchell, 1997



# Landscape – Artificial Intelligence



- ❑ AI – there is no good definition actually, very broad by construction to include everything related to machines performing tasks



# Landscape – Artificial Intelligence



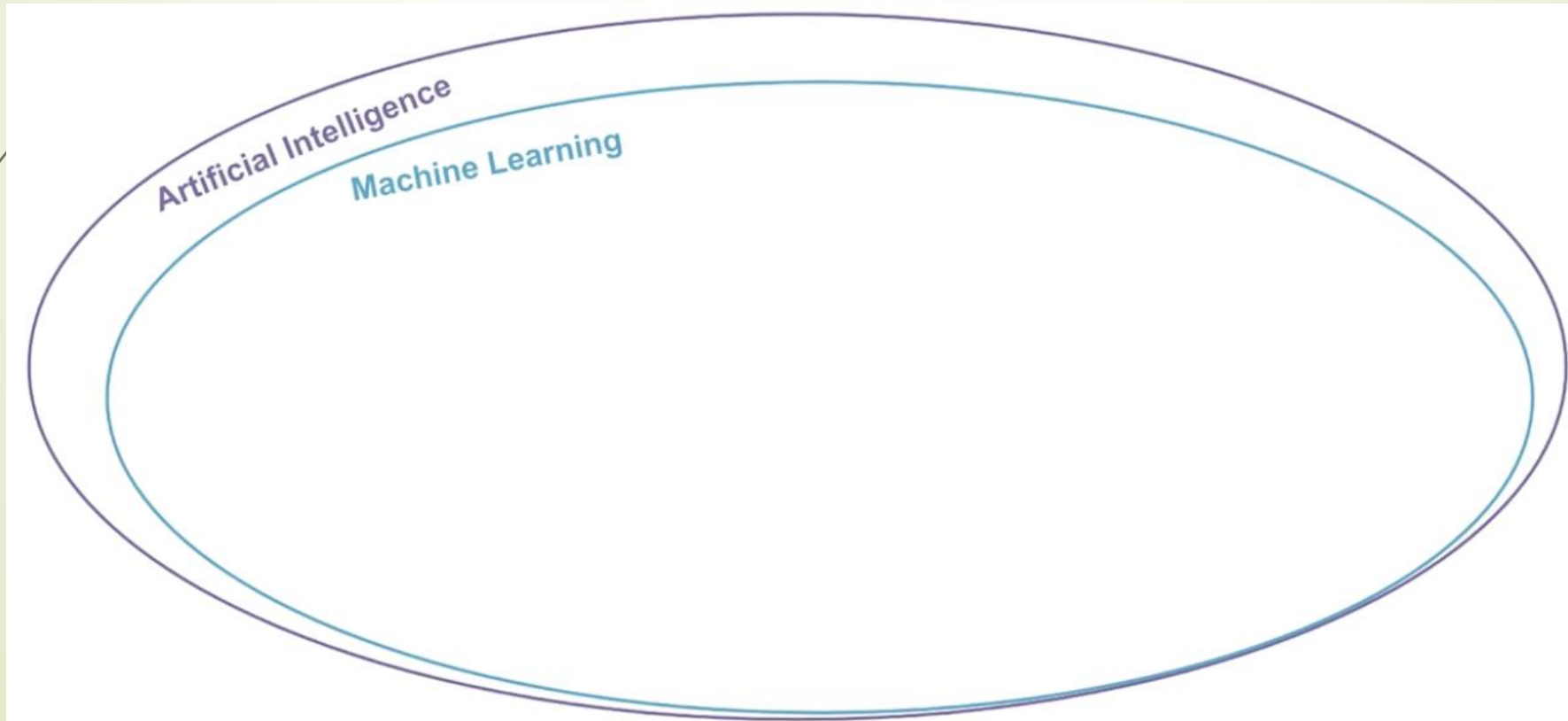
- ❑ AI – **a system that can process information from its surrounding environment and using them to make/achieve a decision/desired outcome**
- ❑ The ultimate goal being to create a general intelligence
- ❑ Any present applications are consider to be a **Narrow Intelligence** (even the ones that already dominate human beings – alpha go)
- ❑ Narrow – because they specialise in one particular task
- ❑ Achieving **General Intelligence** would be a major step (that would not be distinguishable from a human being) – ChatGPT?
- ❑ It probably immediately spark **Super Intelligence**
- ❑ **Is the ML to way to achieve it? Hard to tell now...**



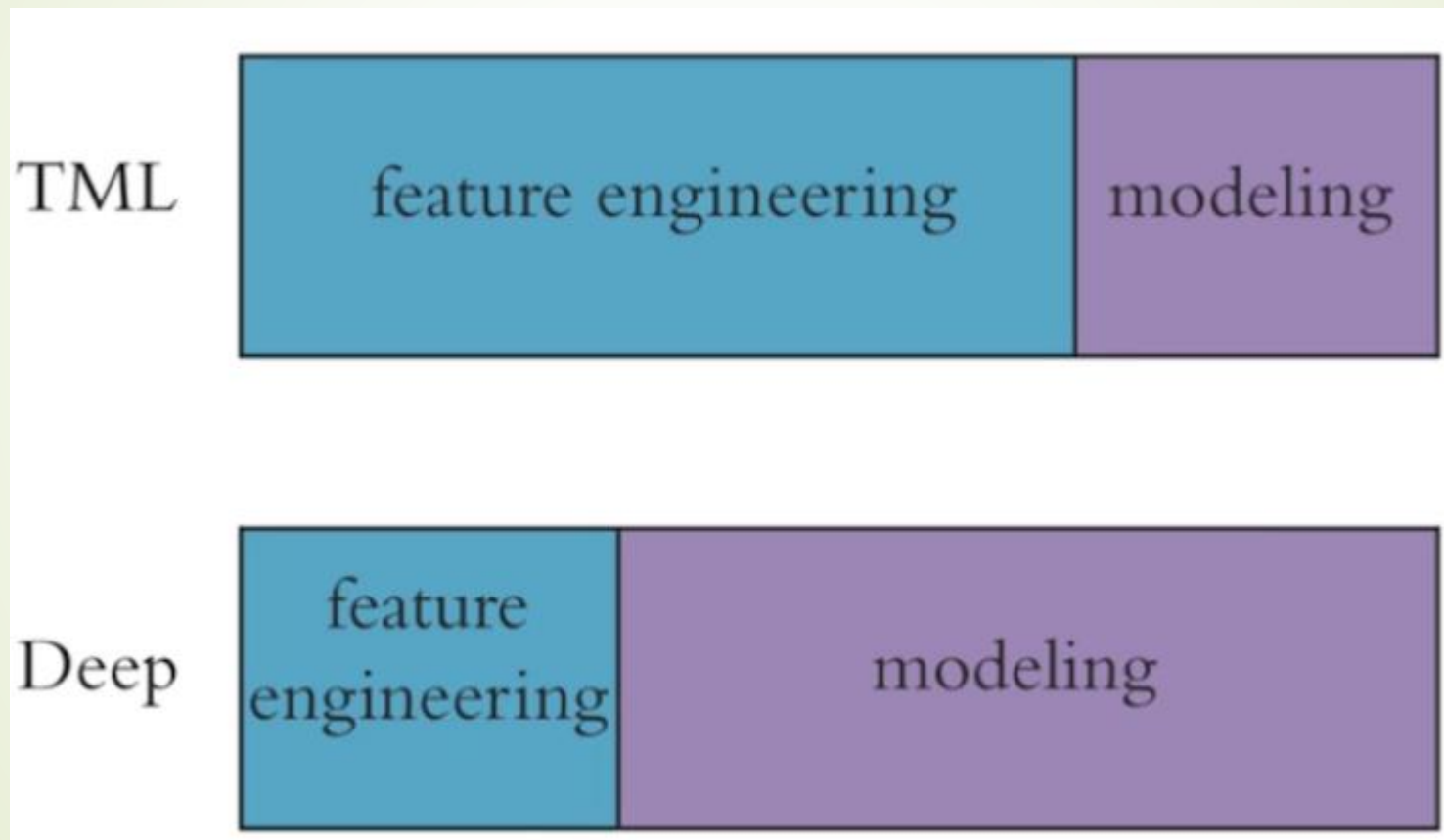
# Landscape – Machine Learning



- ❑ With **ML** we mostly use **software** for interpreting the data without **explicitly coded rules** – however, the programmer should have some idea how to solve the problem



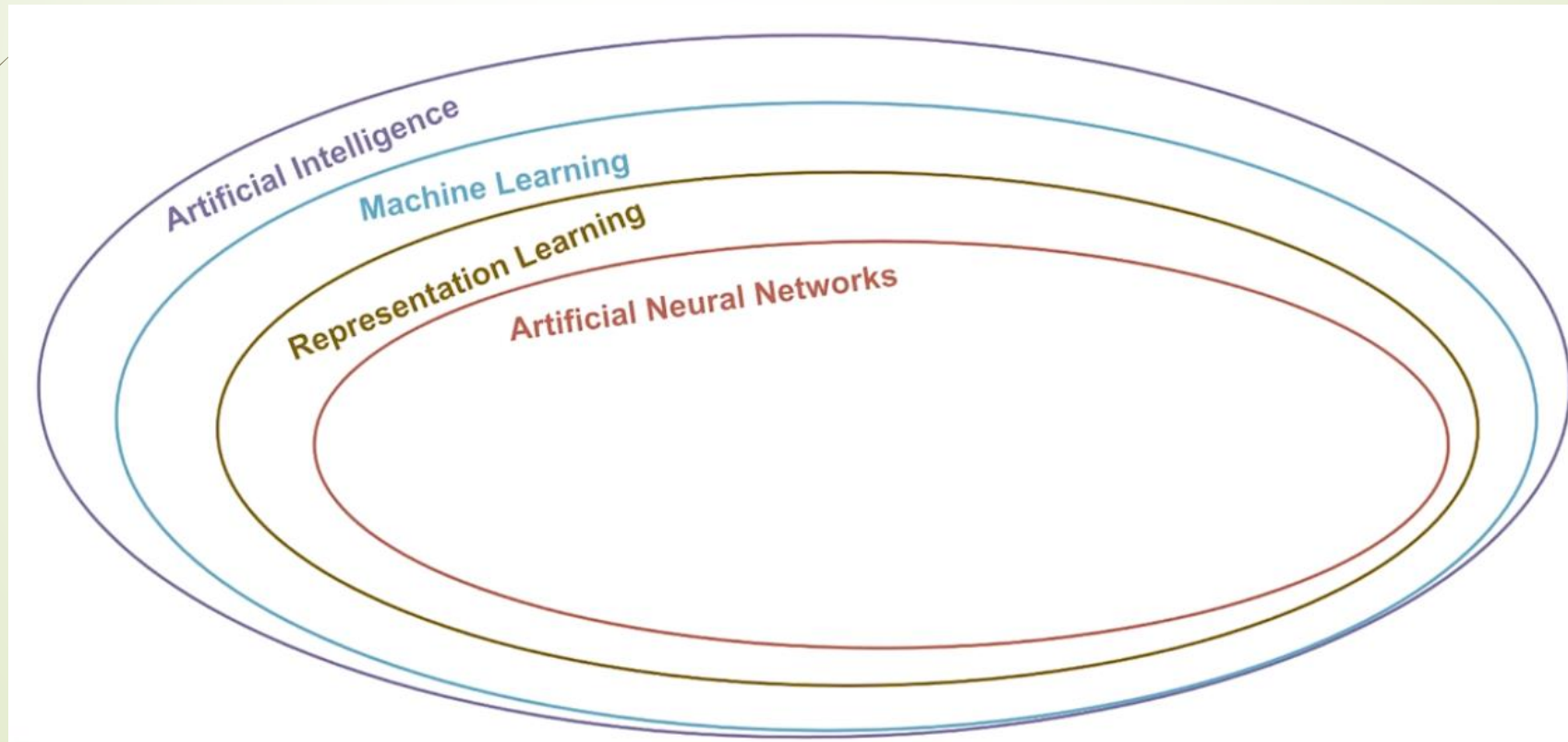
# Landscape – Deep Learning



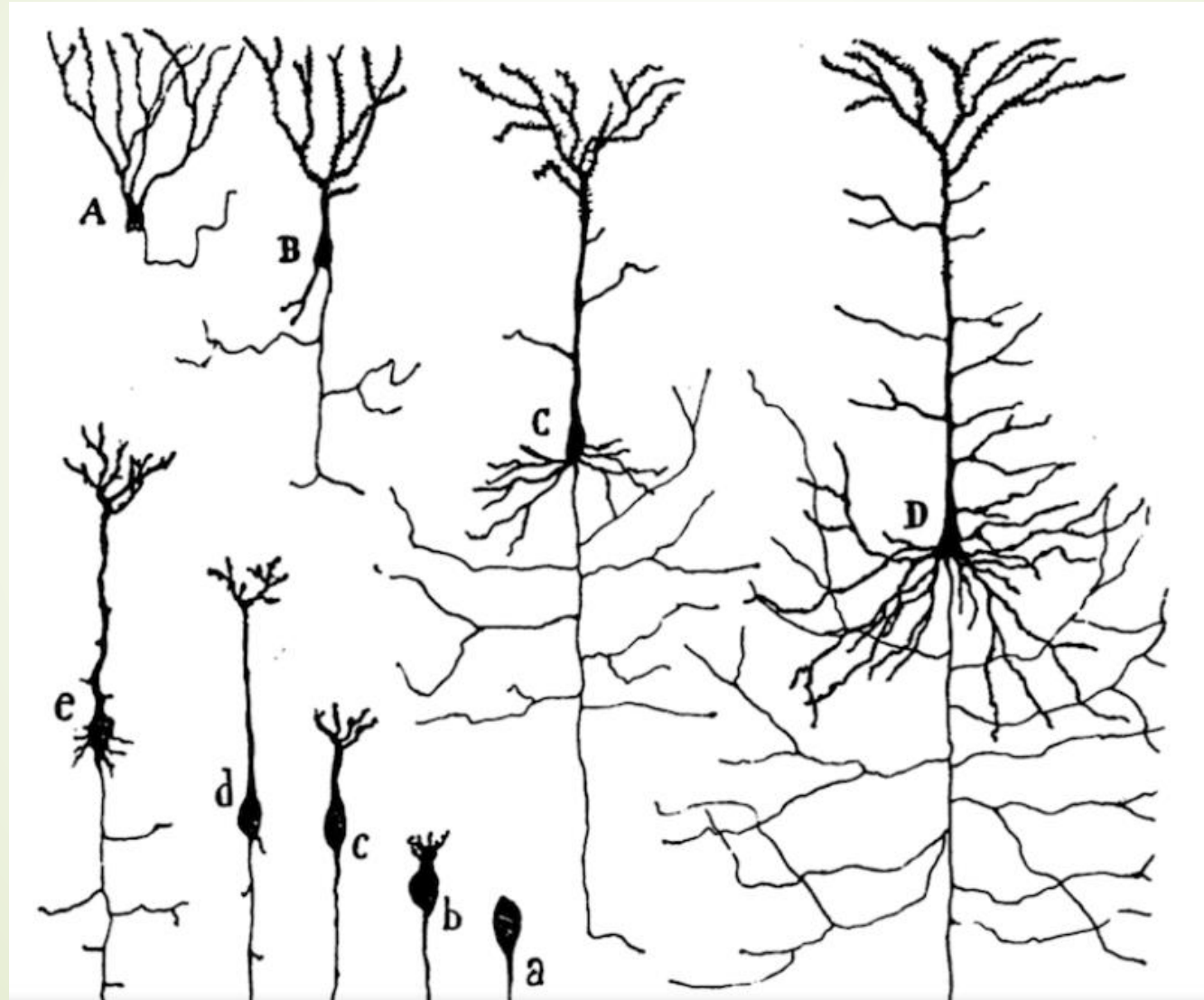
# Landscape – Deep Learning



- ❑ Representation Learning – instead of spending a lot of time, let the model figure out the features. They may be harder to comprehend but we can achieve better results that way!



# ANN – inspiration from biology

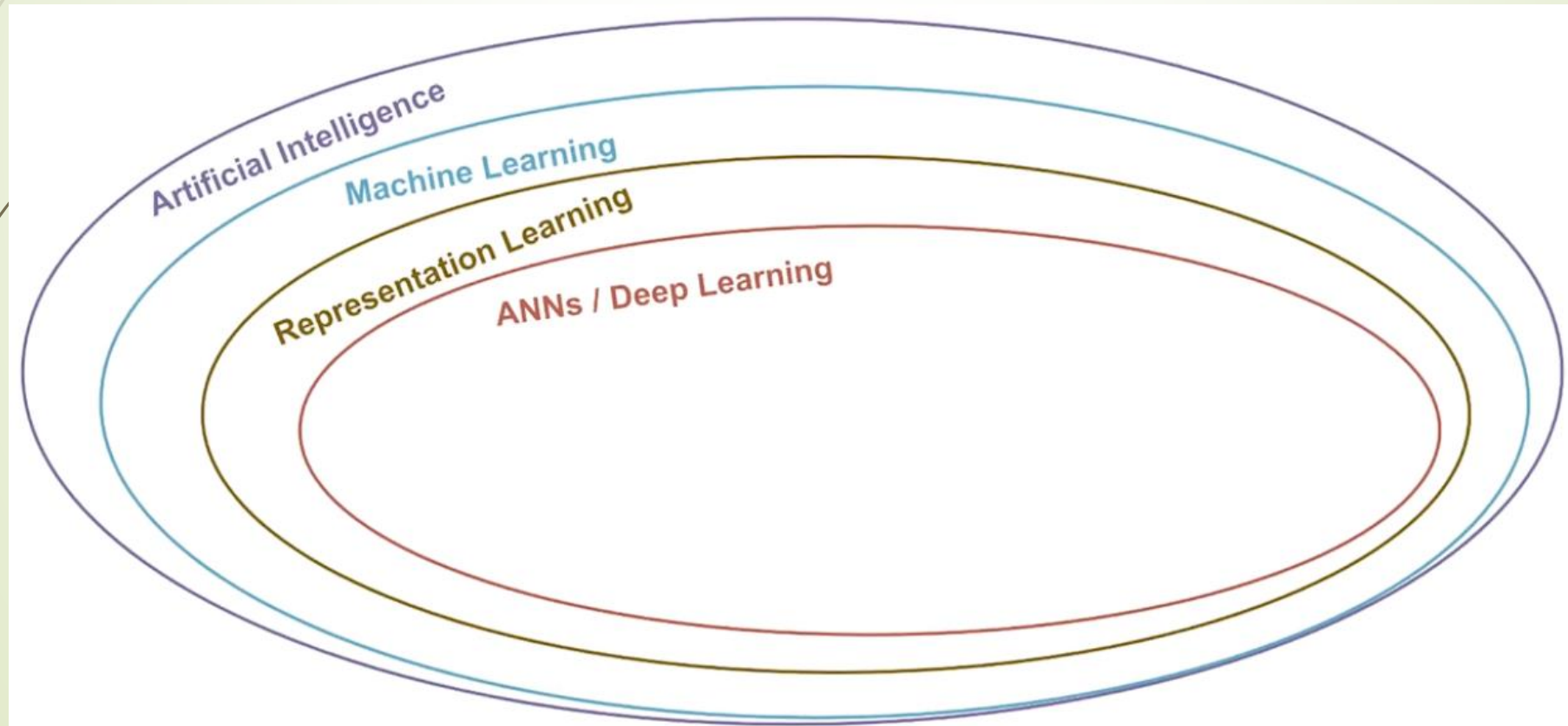




# ANN – inspiration from biology



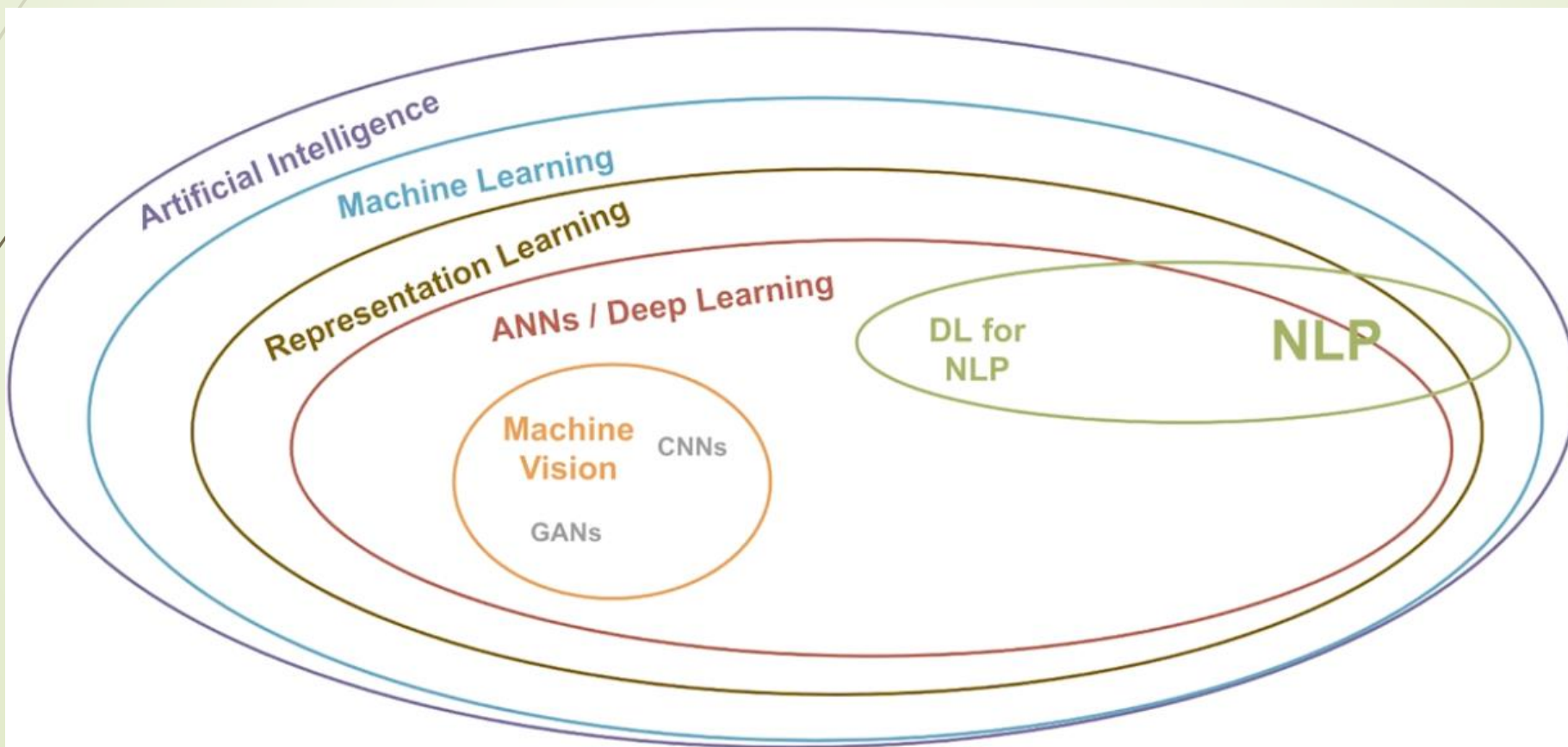
- ❑ Deep learning – ANN with more than 3 hidden layers (so DL ANN must have at least 5 layers – including input/output layer)



# DL – CV and NLP



- ❑ CV completely dominated by DL, NLP more complicated, but with transformers architecture – this may change a lot! NLP crucial for any AI that is suppose to interact with humans

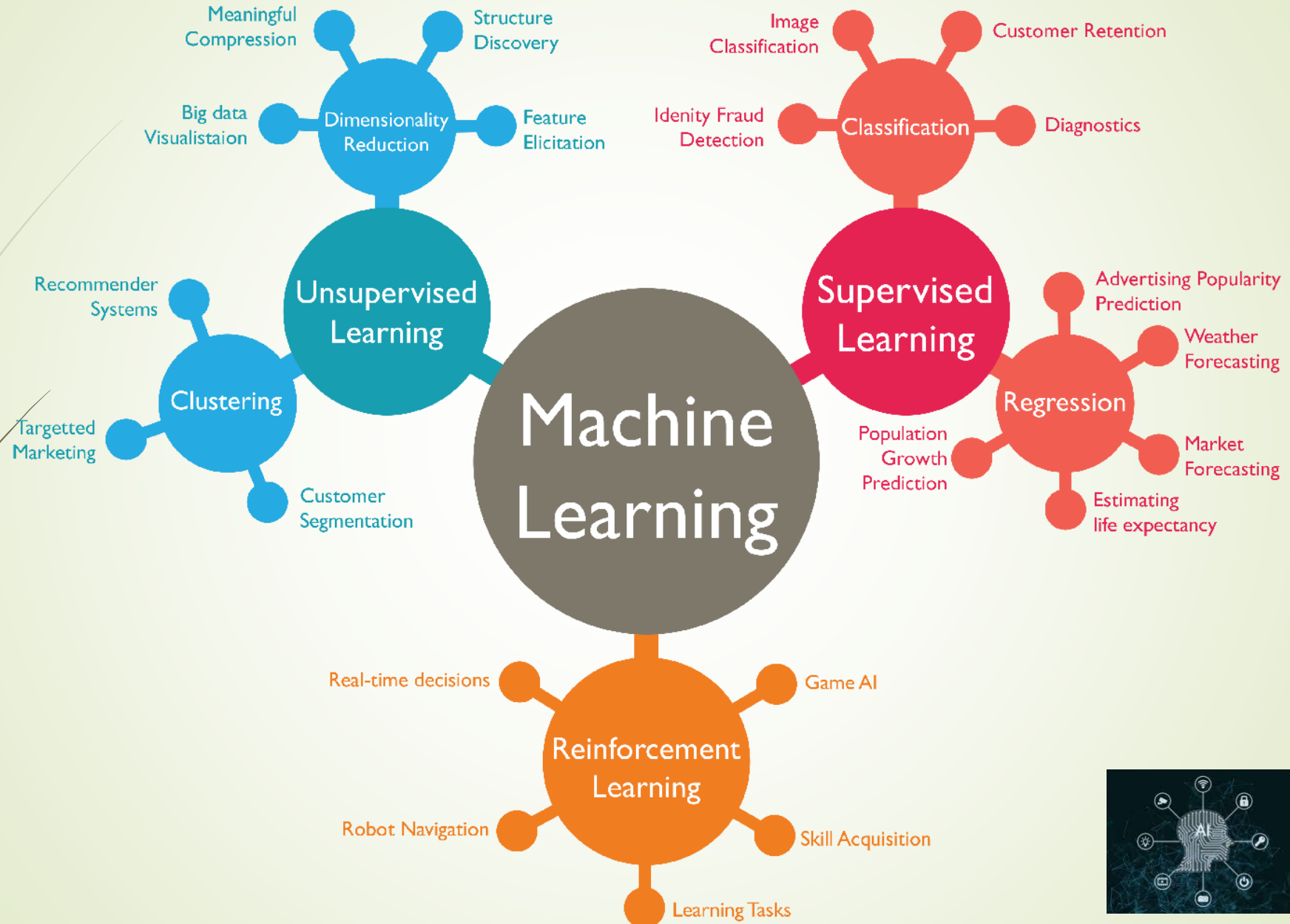




# Deep Learning revolution



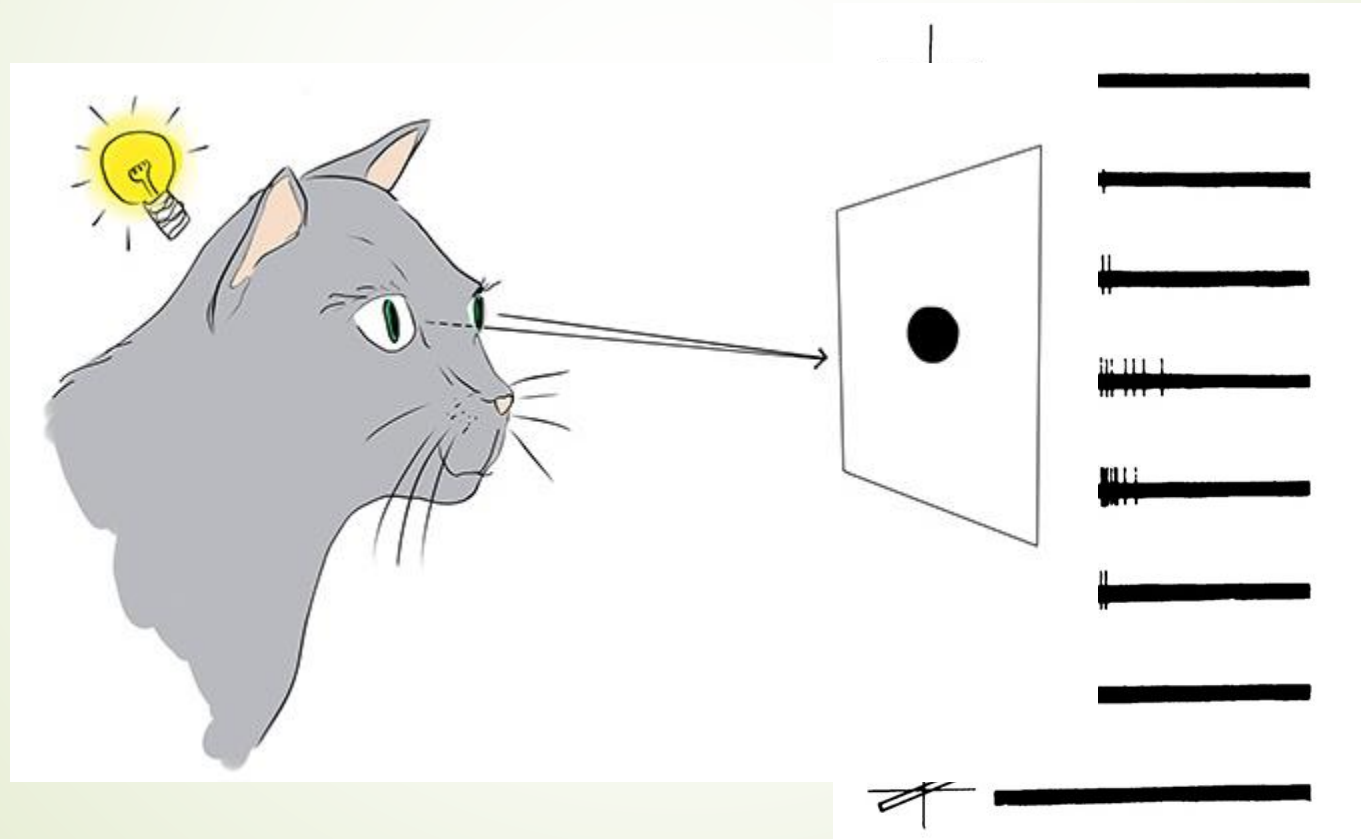
- ❑ Large data sets (~ PB)
- ❑ Processing power increase, multithreading processing, massively parallel capabilities (GPU, TPU)
- ❑ Software development and easy to use high-level platforms



# CV – new brave world



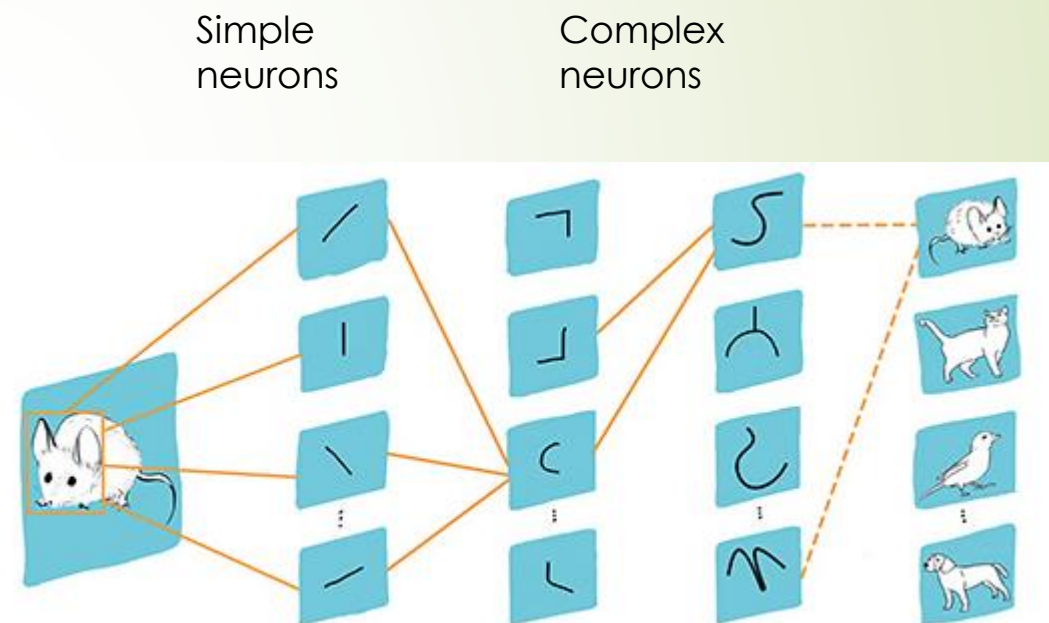
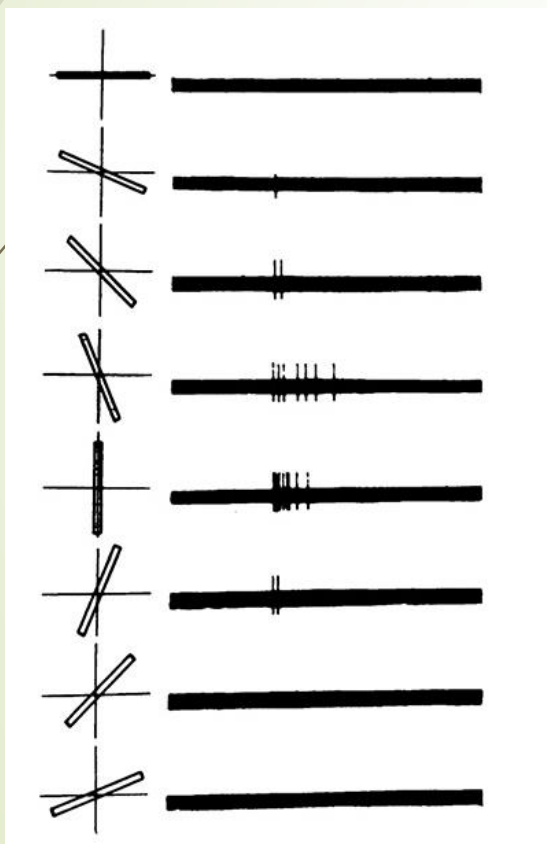
Hubel, D. H., & Wiesel, T. N. (1959). Receptive fields of single neurones in the cat's striate cortex. *The Journal of Physiology*, 148, 574–91.



# CV – new brave world with CNN



Hubel, D. H., & Wiesel, T. N. (1959). Receptive fields of single neurones in the cat's striate cortex. *The Journal of Physiology*, 148, 574–91.



# History of vision

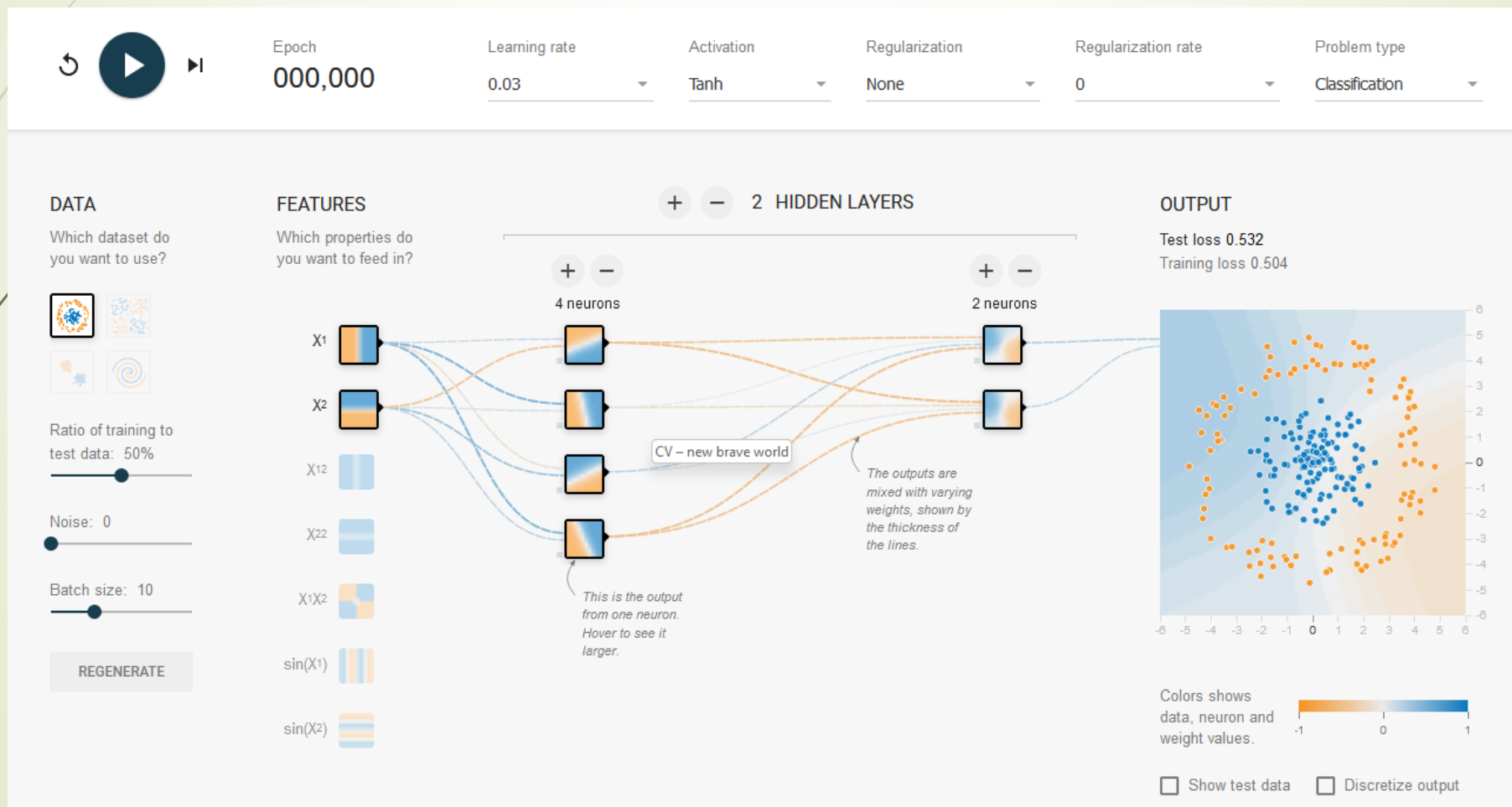


- ❑ From trilobites to DL
- ❑ Nature took about 500 m years to develop an eye
- ❑ It took about 80 to build highly robust DL networks to surpass human capabilities
- ❑ Since 1959 we have had two paths: TML (Viola and Jones) and DL (Neocognitron, LeNet-5, AlexNet, ...)



# Play with DL ANN

<http://playground.tensorflow.org>





The end



# Writting an app

